Silvicultural Evaluation and Prescription for the Panther Fuels and Forest Health Project

1/17/17

Eldorado NF

Amador Ranger District

Amador County, CA

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Landscape Setting

This silvicultural evaluation and prescription is for the Panther Creek Fuels Reduction and Forest Health Project being planned on the Amador Ranger District of the Eldorado National Forest. The Panther Fuels Reduction and Forest Health (Panther) Project area is located between Panther Creek Road and Ellis Road, south of Highway 88 and north of the 2004 Power Fire footprint in Amador County, CA. The total project area is approximately 5,400 acres. Elevations of the project area range from approximately 4,200 to 6,675 feet. The area is in the Sierra Nevada mixed conifer forest type consisting of sugar pine (pinus lambertiana), ponderosa pine (pinus ponderosa), incense cedar (calocedrus decurrens), Douglas fir (pseudotsuga meziesii), and white fir (abies concolor). There is also a component of California black oak (Quercus kelloggii) found primarily near ridgetops or in openings. The average annual precipitation is approximately 40" with at least some portion coming as snow.

Site and Stand Conditions

In general the stands chosen for treatment are dense with a wide range of diameter classes represented throughout. Stands have abundant ladder fuels primarily in the form of shade tolerant conifer regeneration. There are numerous large trees (>than 40" diameter at breast height (DBH)) and the canopy is generally closed with very little sunlight reaching the forest floor.

Vegetation Inventory

Using Common Stand Exam protocol data was collected on standing trees as well down dead fuel loadings though out the project area. Data was then analyzed to quantify the existing conditions as well as to model treatments and future stand conditions.

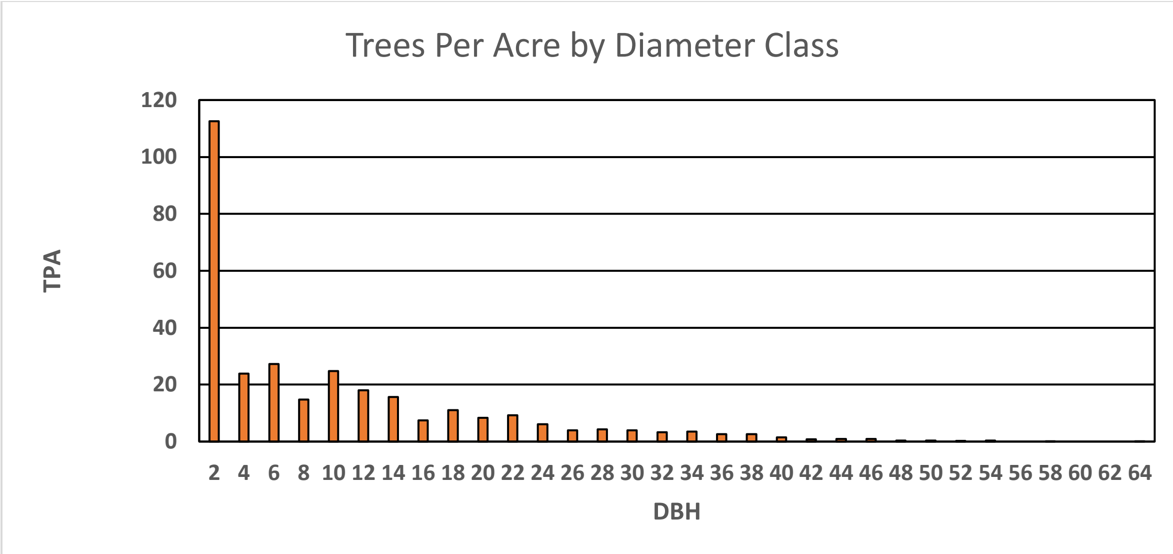
Stand Density and Tree Size

As previously stated many of the stands are dense with the existing basal area (BA) averaging 309 sq. ft. per acre. There are on average 343 trees per acre (TPA) although approximately 200 of them are under 10" DBH. See Table 1 and Figure 1. The Quadratic Mean Diameter (QMD) is 14.2 in. QMD is the diameter of the tree of average per tree basal area.

Table 1. Stand Table of Existing Condition

Diameter Class	Live TPA	BA/AC
2	112.5	1.5
4	23.9	2
6	27.3	5.2
8	14.8	5.3
10	24.8	13.4
12	18	13.6
14	15.7	16.4
16	7.5	10.5
18	11.1	19.5
20	8.4	18.2
22	9.3	24.5
24	6.1	19.1
26	3.9	14.5
28	4.3	18.2
30	3.9	19.1
32	3.3	18.6
34	3.5	21.8
36	2.6	18.2
38	2.6	20
40	1.5	13.2
42	0.8	7.3
44	0.9	9.1
46	0.9	10
48	0.4	5
50	0.4	5
52	0.2	2.7
54	0.3	4.1
56	0	0.5
58	0.1	1.8
60	0	0.9
62	0	0
64	0.1	1.8
66	0	0.4
68	0	0
70	0	0.9
72	0	0
74	0	0.5
76	0	0.5
All	**308.9**	**343.4**

Figure 1. Trees per Acre by DBH Existing Condition.



Stand Density Index (SDI) can be used as an indicator of stand density and potential risk of insect attack. It is applicable regardless of site class or age. SDI can be compared to a maximum stand density index. Stands which are rated at 55% of the maximum SDI or above are considered to be imminently susceptible to insect attack due to inter-tree competition. This does not mean that an attack will happen, only that it is likely. At the lower end (55%) would indicate a high likelihood of mortality concentrated in the lower crown classes and the more shade-intolerant species. At higher densities, mortality would be expected across all size classes (Bakke, 1997). However, even some stands at lower densities can be subject to insect attack due to intertree competition. Oliver (1997), in a study of a westside Sierra ponderosa pine plantation, found mortality, from bark beetles and snow damage, was confined almost exclusively to stands with SDIs of more than 183, 32% of maximum SDI for ponderosa pine.

The current total average stand density index is 547 (Table 2). If using the default maximum SDI for ponderosa pine of 571 provided by the Forest Vegetation Simulator (FVS) Western Sierra Nevada Variant (Keyser, Chad E., Dixon, Gary E., comp. 2008 (revised November 2, 2015), the current stand is at 96% of maximum and at extremely high risk of mortality. As shown in table 2, 36% of the total SDI is in trees over 30" which are restricted from management by Forest Wide Standard and Guideline # 6 in the Sierra Nevada Forest Plan Amendment (SNFPA) when doing harvests for controlling stand densities.

Table 2. Stand Density Index by selected diameter classes.

Diameter	SDI	% of total
1 - 9.9 in	93	17%
10 - 29.9 in	256	47%
30 - 70.9 in	198	36%
Total	**547**	100%

Species Composition

As shown in table 3, the project area currently has a larger percentage of shade tolerant species than pine. Although pine only comprises 23% of the trees per acre, it actually represents 35% of the basal area. This is due to the presence of the scattered large pines that remain in the project area. As with many mixed conifer stands that have seen extended periods of fire suppression, the shade tolerant are becoming the dominant species. Although the white fir and incense cedar make of most of the smaller sized trees in the project area, there are numerous in the co-dominant and even dominant crown classes.

Table 3. Stand Attributes by Species

Species	TPA	% of total	BA/A	% of total
WF	94	30%	101	29%
IC	134	43%	117	34%
SP	20	6%	48	14%
PP	54	17%	71	21%
BO	7	2%	6	2%
Total	**309**		**343**	

Canopy Cover

Based on the plots collected the average canopy cover for the project area was estimated by FVS to be near 100%. This estimate was generated using a canopy model that does not account for overlapping tree crowns and there for tends to overestimate total canopy cover. The ENF Vegetation Geographic Information System (GIS) Layer shows that there are approximately 3,668 acres in the project area that have greater than 50% canopy cover. Of that, approximately 2,124 acres are greater than 70% and 780 acres are greater than 80%.

Bark Beetle Mortality

As with much of the surrounding area, there is recent mortality in the ponderosa pine due to western bark beetle activity. At the time of data collection (2014) there was only limited recent mortality in the project area and seemed to be isolated to a few groups of 10 trees or less. Since then mortality has continued to occur and there is no comprehensive survey data to determine area or number of trees effected in the project area.

Past Silvicultural Activities

Portions of the project area have had multiple silvicultural treatments over the last 50 years. Most recent have been thinning and fuel reduction treatments under the Mokey Bear and View 88 Projects. However other areas in the project have had little to no management except for scattered salvage harvest that occurred in 1992. This was associated with a large scale insect salvage that was occurring across the entire Amador District.

Management Objective
Direction: Law, Regulation, Policy

Direction for land management in the Eldorado National forest comes from the Eldorado National Forest (ENF) Land and Resource Management Plan (LRMP, 1988), and the Sierra Nevada Forest Plan Amendment (SNFPA, 2004). Primarily fuels and vegetation management projects are directed by the desired conditions, management intents and management objectives in the SNFPA.

The Panther Project is located in a Wildland Urban Intermix (WUI) Threat Zone land allocation which has desired conditions that primarily focus increasing the ability to suppress wildfires. However an additional desired condition is to have tree density reduced to a level consistent with the site's ability to sustain forest health during drought conditions.

The management intent states: Threat zones are priority area for fuels treatments.

- Fuels treatments in the threat zone provide a buffer between developed areas and wildlands.
- Fuels treatments protect human communities from wildland fires as well as minimize the spread of fires that might originate in urban areas.
- The highest density and intensity of treatments are located within the WUI.

The management objectives are to: Establish and maintain a pattern of area treatments that is effective in modifying wildfire behavior. Design economically efficient treatments to reduce hazardous fuels.

The Project area also contains three California Spotted Owl (CSO) Protected Activity Centers (PACs) as well as well as a Goshawk PAC. Each CSO PAC has a corresponding Home Range Core Area (HRCA). The desired conditions for the HRCA are to have (1) at least two tree canopy layers; (2) at least 24 inches dbh in dominant and co-dominant trees; (3) a number of very large (greater than 45 inches dbh) old trees; (4) at least 50 to 70 percent canopy cover; and (5) higher than average levels of snags and down woody material.

Forest-wide Standards and Guidelines for mechanical thinning that apply to the Panther project include:

- Retain all live conifers 30 inches dbh or larger.

- Design projects to retain at least 40 percent of the existing basal area. The retained basal area should generally be comprised of the largest trees.
- Where available, design projects to retain 5 percent or more of the total treatment area in lower layers composed of trees 6 to 24 inches dbh within the treatment unit.
- Design projects to avoid reducing pre-existing canopy cover by more than 30 percent within the treatment unit. Percent is measured in absolute terms (for example, canopy cover at 80 percent should not be reduced below 50 percent.)
- Within treatment units, at a minimum, the intent is to provide for an effective fuels treatment. Where existing vegetative conditions are at or near 40 percent canopy cover, projects are to be designed remove the material necessary to meet fire and fuels objectives.
- Where existing vegetative conditions permit, design projects to retain at least 50 percent canopy cover averaged within the treatment unit. Exceptions are allowed in limited situations where additional trees must be removed to adequately reduce ladder fuels, provide sufficient spacing for equipment operations, or minimize re-entry. Where 50 percent canopy cover retention cannot be met for reasons described above, retain at least 40 percent canopy cover averaged within the treatment unit.

Species Composition- There is Forest-wide direction to promote shade intolerant pines (sugar and Ponderosa) and hardwoods.

Timber Volume

Although timber production is not a clearly stated objective in the 2004 SNFPA, there is recognition that without a predictable supply of timber products, local mills will continue to close and our ability to treat National Forest lands becomes even more difficult. It is explicitly stated that fuels treatments should be economically efficient. On the Eldorado National Forest, with the use of Stewardship Contracting, timber value has been used to treat thousands of acres for fuels reduction in an economically efficient manner. The Panther project acknowledges this need by stating there is a need to provide wood fiber for purposes of job creation and public consumption, thereby contributing towards a landscape capable of producing a sustainable supply of natural resource materials. The removal of timber as an objective of National Forest System Lands is clearly backed laws such as the Organic Act of 1897, Multiple Use Sustained Yield Act of 1960 and the National Forest Management Act 1976.

Project Level Objectives

The existing conditions in the Panther Project Area have created the following specific needs:

1. There is a need to reduce surface and ladder fuels, thus creating stands less susceptible to adverse wildfire effects. In addition there is a need to remove dead trees that threaten the short and long term goals of managing fuel loadings, and reducing adverse wildfire effects.

2. There is a need to promote healthy forest stands that are resistant to drought, insects and disease, and to protect and provide habitat for plant and wildlife species through time.

3. There is a need to maintain strategically-placed fuel treatments in a manner that significantly reduces wildland fire intensity and rate of spread, thereby promoting safe fire suppression, protection of human life and property, and protecting/retaining resource and socio-economic values within and adjacent to the project area.

Fuel Break

The Panther Project proposes a series of fuel breaks along major roads and ridges. The specific objectives of the fuels breaks include providing an effective control point for fire suppression in the event of a large wildfire and to provide breaks in the landscape to stop smaller fires, and to slow down larger ones before reaching the main ridges.

Stand Density

To add further direction to the need for managing stand densities for forest health, a letter from Regional Forester Jack Blackwell was issued on July 14, 2004. It gave a goal of designing thinnings to ensure that density does not exceed an upper limit (for example: 90% of normal basal area, or 60% of maximum stand density index) for approximately 20 years post treatment. This guidance will be used determining target residual densities for the project.

Although overall goals and direction for vegetation management are provided by the 2004 SNFPA, much interest and emphasis has more recently been put on concepts provided in the Pacific Southwest Research Station General Technical Report 220 (PSW-GTR-220) An Ecosystem Management Strategy for Sierran Mixed-Conifer Forests. This document aimed at consolidating recent scientific literature in order to reach some balance between fuels reduction, ecosystem restoration, and maintaining wildlife habitat for key species such as California spotted owl.

Prescriptions will be designed to meet the following GTR-220 goals:

- Reduce shading around oaks to improve growing conditions.
- Increase the percentage of shade intolerant pine and hardwoods.
- Retain clumps of large trees.
- Retain large trees with defects such as rot, cavities, and multiple tops.
- Improve forest resiliency by reducing stand densities by thinning
- Manage the intermediate size class (20 to 30 inch DBH), thinning this class primarily by species (shade tolerant) and growth form (those acting as ladder fuels).
- Increase stand variability. Target stand structure would consist of a mixture of clumps, gaps and a matrix of variably spaced trees. Small (.25 acre or less) gaps will be created or enlarged in low productivity sites and where natural openings in the canopy exist.

<u>FVS-Growth, Mortality and Treatment Modeling</u>

Stands were modeled using the FVS program under a no action scenario to use as a baseline comparison for prescribed treatments. Next the 3 action alternatives were modeled. All model runs were done using a fifty year time year period (through 2066).

No Action

With no action, average basal area in 2066 would be 298 sq.ft./ac. and there would be approximately 91 trees per acre. The QMD would increase to 24.5 inches. Figure 2 shows the diameter distribution that would occur in 2066.

Figure 2. Trees per Acre by DBH-No Action Year 2066

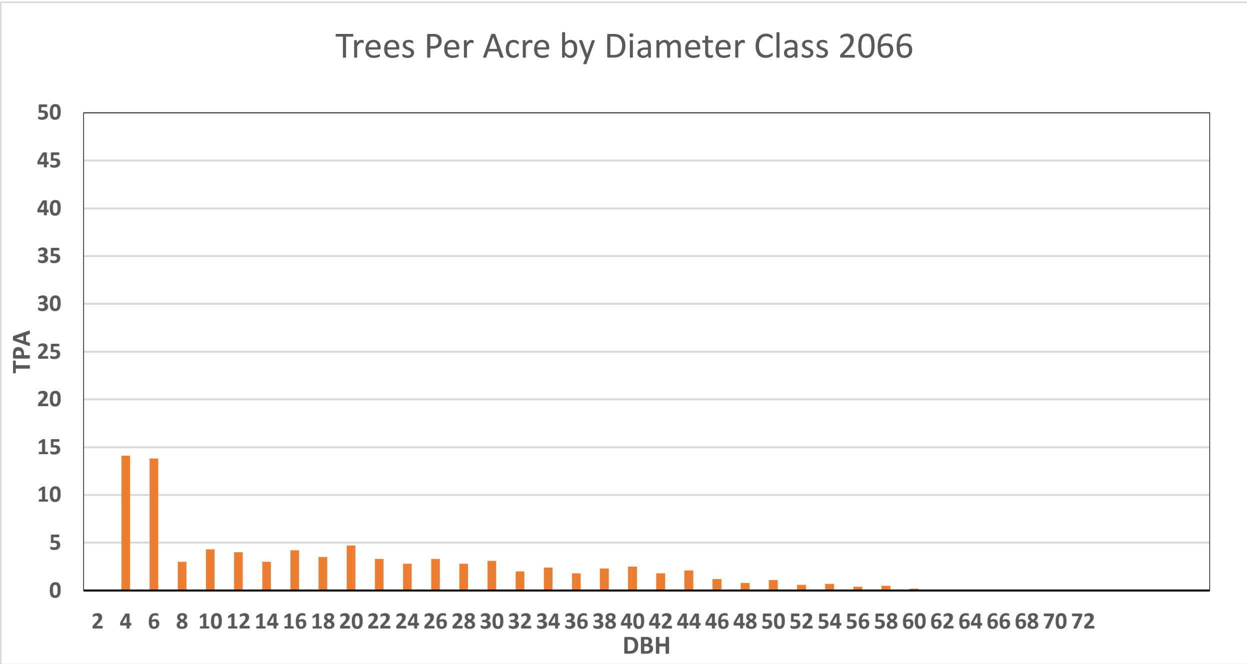


Table 4. SDI by Select Size Classes in Year 2066

Diameter	SDI	% of total
1 - 9.9 in	34	9%
10 - 29.9 in	111	29%
30 - 70.9 in	238	62%
Total	**383**	100%

Table 5. Stand Attributes by Species in Year 2066

Species	TPA	% of total	BA/A	% of total
WF	33	36%	100	33.6%
IC	40	44%	97	32.6%
SP	6	7%	58	19.5%
PP	11	12%	42	14.1%
BO	1	1%	1	0.3%
Total	**91**		**298**	

<u>Discussion of Results from No Action</u>

One of the primary goals of the prescription for the project is to improve forest health through managing stand density. Stand density index is the primary measure that will be used to set a target residual stand density in order to maintain conditions at lower risk for mortality from insect and disease. However in order to actually compare the effects of managing stand density, total accrued mortality will be modeled and reported under the action and no action alternatives. With no action the total accrued mortality that is estimated to occur 50 years is 7,122 gross cubic feet per acre. To put into perspective, this is 83% of the expected growth that is projected to occur over the same timeline.

As shown in table 4, SDI does decrease overtime with no action, however this is a direct result of competition induced mortality. Even with the reduction of SDI through mortality, in 50 years the stand is still at 67% of maximum, which is above the desired target. As shown in table 5 the percentage of pine in the stand actually slightly drops over time as compared to the existing condition.

The resulting mortality under no action will also contribute to down and dead fuel loading through time. This will fail to meet the other primary goals of this project which is to reduce fire severity and intensity. In addition to increased fuel loadings, increased snag levels may pose a threat to the fuel break strategy.

Canopy Cover

Over time canopy cover slowly declines as mortality occurs in the stand. By year 50 canopy cover for the stand is estimated to be 72%.

Fire and Fuels

Current levels of ladder fuels will continue into the future as shade tolerant trees will survive and slowly grow. In the short term height to the base of live crowns would remain the same, resulting in an increased probability of stand replacing fire. Height to the base of live crowns of larger trees will slowly increase as lower branches die from lack of sufficient sunlight. Ground fuels would continue to accumulate, without disturbance, from dead branches and within stand mortality.

<u>Alternative 1-Proposed Action</u>

<u>Silvicultural Prescription for Commercial Harvest Units</u>

Uneven-Aged, Thinning, Salvage and Group Selection

In order to meet the above stated objectives the prescribed silvicultural methods for the Panther Project will include a harvest cutting using commercial thinning along with ladder and surface fuels treatment. The commercial thinning will be a combination of thinning from below and free thinning. Using the Society of American Foresters' (SAF) The Dictionary of Forestry definition, free thinning is the removal of trees to control stand spacing and favor desired trees, using a combination of thinning criteria without regard to crown position. (SAF, 1998) Free thinning seems to be the best description of the variable spaced thinning desired to create stand level heterogeneity. Although the stand is currently un-evenaged, what is being proposed in not a true un-evenaged system. This due to the fact that there is no attempt being made to allocate or maintain stocking to all size classes.

As stated previously a primary goal of treating stands in the project area is to reduce stand density in order to increase resiliency to drought, insects and disease. The desired residual stand density index will range between 200 and 220. Using the maximum stand density for ponderosa pine of 571, this would keep the risk for density related mortality below "imminent" for approximately 20 years. Given that the stand is on a southwest aspect at approximately 5000 ft. elevation, it is reasonable to believe this would be a pine dominated site under historical fire return intervals.

In order to reach the desired stand density index the stands will be thinned to a residual basal area of between 120 and 150 square feet.

In general, lowest residual stand densities would occur on upper slopes, ridges and southern and western aspects. Targeted residual density would range from 100-140 square feet/acre basal area or approximately 25-30 feet tree spacing. Although canopy cover would average 50% over treatment units, lower canopy cover would exist in these less dense areas. On lower slopes and transitioning into Riparian Conservation Areas (RCA), residual stand densities may be higher with a corresponding increase in canopy cover. Targeted residual density would range from 140-180 square feet/acre basal area or 20-25 feet tree spacing. Canopy Cover in RCAs of perennial and intermittent streams would see the least overall reduction and would likely average closer to 60%.

Preference for leave tree species will be ponderosa pine and sugar pine then incense cedar and finally white fir. Tree characteristics such as growth form, live crown ratio, presence of insect or disease, and crown position will all be used to choose desirable leave trees. In general intermediate and suppressed trees will be removed, however, co-dominants while be selected for cutting in order to achieve desired residual stand density. Primarily, co-dominants selected for removal will be incense cedar and white fir.

On all acres included in the project for commercial harvest, recently killed trees (snags) would be cut and removed concurrently with logging operations without restriction on dbh.

The majority of pre-commercial sized trees will be cut and removed on mechanically logged units. This is to remove trees that are acting as ladder fuels. Exceptions will be made for individual trees that are adequately spaced both horizontally and vertically from desired leave trees. In other words desirable trees under 10" dbh that are in canopy openings may be left. In general pre-commercial trees would be left at approximately 25 ft. spacing from residual merchantable trees. If existing in clumps that are adequately spaced from merchantable trees, sub-merchantable trees will be thinned to an average of 18 ft. spacing. Considering that the stands have dense canopies, the majority of advanced regeneration is shade tolerant which will make for desirable leave trees in the understory. Gaps created through commercial thinning will rarely be sufficient to promote pine species.

Existing surface fuels along with any added activity fuels will be tractor piled and burned on mechanically logged units.

In addition to thinning, on approximately 75 acres group selection will be used to create small openings (1 to 2 acres in size) by removing conifer species to promote pine regeneration. Areas would be located in and adjacent to areas with symptoms of annosus root rot infection, areas currently dominated by white fir and where concentrations of recent mortality has occurred. Individual openings where mortality has occurred may be greater than 2 acres in size. Regeneration will occur through natural seeding as well as planting. For annosus areas, treat stumps of surrounding area with borax fungicide (Sporax or equivalent formulation). The total area treated in these openings would be approximately 75 acres. Openings would be reforested with a mix of pine species: ponderosa pine, Jeffrey pine, sugar pine. Conduct one to two release treatments using manual methods. Evaluate seedling survival and interplant if necessary in order to achieve desired level of stocking in pine species. In 5-7 years post-harvest, conduct pre-commercial thinning (PCT) in order to achieve desired level of stocking in pine species.

Operational-Logging System

679 acres will be harvested using mechanized ground based logging methods including whole tree yarding. This will consist of a feller buncher and rubber tired skidder. Some hand falling may occur for trees larger than 24" dbh. Non-commercial sized trees will be cut and removed using the same equipment and concurrently with logging operations.

104 acres will be harvested using a skyline logging system. Feller bunchers or equivalent type of ground based equipment may be used for cutting and pre-bunching of logs that would be removed using a skyline logging system. Use of equipment in skyline units would be limited to 45% slope.
Piling may take place at later date as well as prescribed burning.

Schedule of Treatment

2018- Commercial Thin, Group Selection, Small tree removal, piling

2019-2020- Prescribed burning, Planting of Group Selections

2021-2023- Hand Release in Group Selections

2025- Pre-commercial Thin in Group Selections

<u>Results from Commercial Harvest Prescription Implementation</u>

Post treatment there will be approximately 60 trees per acre and basal area is reduced to 210 sq. ft./ acre. The QMD is increased to 25.5 inches.

Tables 6, 7, and 8 along with Figure 3 show results from modeling both 1 year post-harvest as well as into the future.

Figure 3. Trees per Acre by DBH-1 yr. Post Harvest Year 2019

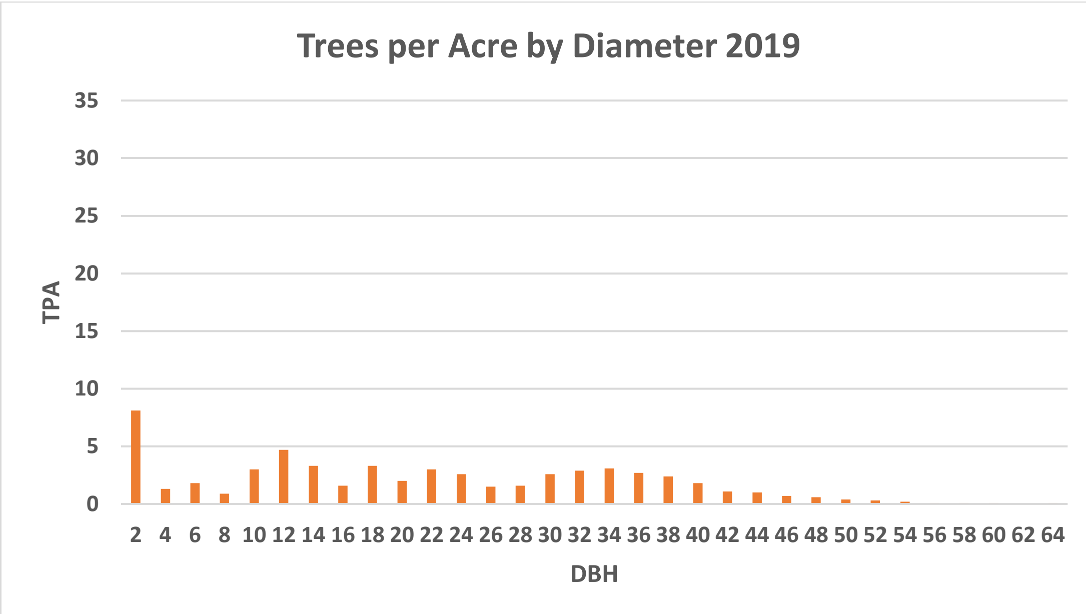


Table 6. SDI by Select Size Classes

Diameter	SDI	% of total
1 - 9.9 in	13	5%
10 - 29.9 in	79	30%
30 - 70.9 in	174	66%
Total	265	100%

As shown in table 11, SDI is reduced to approximately 265 or 46% of maximum.

Table 7. Stand Attributes by Species 2019

Species	TPA	% of total	BA/A	% of total
WF	18	31%	70	33%
IC	16	27%	42	20%
SP	7	12%	46	22%
PP	14	24%	48	23%
BO	4	7%	4	2%
Total	**59**		**210**	

Table 8. **Stand Attributes by Species 2066**

Species	TPA	% of total	BA/A	% of total
WF	16	32%	91	33%
IC	14	28%	59	21%
SP	6	12%	69	25%
PP	11	22%	55	20%
BO	3	6%	3	1%
Total	**50**		**277**	

Without any future management, SDI reaches 321 or 56% of maximum in 50 yrs. However modeling shows that SDI does remain below the stated target of 55% of maximum for at least 20 years post treatment.

Timber Volume

Based on the summary statistics table in FVS, 2,046 merchantable cubic ft. per acre (10,827 merchantable board ft.) would be produced. For the total project (783 acres) this would equate to 16,020 hundred cubic feet (CCF) or 8.5 million board feet (MMBF).

<u>Discussion of Results from Implementing Prescription</u>

The post treatment diameter distribution is shown in figure 3. Much of the reduction in trees per acre takes place in the less than 10” DBH size classes.

The prescription as modeled has reduced stand density and kept it at an acceptable level at least the first 20 years of 50 year modeling period. In addition the composition of the stand has been modified to make pine a larger percentage of both trees per acre as well as basal area. The total accrued mortality over the 50 year modeling period is 3,217 gross cubic feet per acre. This is approximately 45% of the growth for the same period. Almost half of this mortality actually occurs in first two years of the modeling period prior to the scheduled treatment, so the mortality post treatment is much less. In comparison to the no action mortality has been considerably reduced. As stated previously, 7,122 gross cubic feet per acre is projected to die with no action taken, which is 83% of the growth over that same period.

Another objective of the prescription was to promote pine. Although this thinning prescription is not intended to initiate regeneration it does increase the percentage of the stand that is made up by pine species. Table 8 shows that both the number of trees per acre as well as basal area made up of pine is increased by implementing the prescription. Post treatment, pine species would make up 36% of the trees per acre as compared to 23% in the current condition and no action.

Group Selection

In the areas of group selection, reforested areas would be dominated by pine species. Due to the relatively small size, natural regeneration of shade tolerant species (white fir and incense cedar) will continue to occur over time. Pre-commercial thinning will keep these areas at low risk of density related mortality for at least 20 years. Manual removal of brush and grass/forb vegetation will promote survival and early growth of seedlings. However maintenance treatments may be needed in the future as re-sprouting brush species grow back and pose a fuels concern and continue to compete with young trees.

Canopy Cover

Canopy cover is modeled to be approximately 56% post-harvest. This is above the average canopy cover of 50% that is prescribed the by SNFPA. Again assuming this particular canopy model is estimating higher than what would be on the ground, it is reasonable to predict that by implementing the modeled prescription, an average of 50% will be achieved.

Fire and Fuels

Removing ladder fuels (suppressed and intermediate trees) would increase the height from the ground to the base of live crowns. The effect would be to reduce the possibility of stands torching or crowning during a wildland fire.

Post harvest treatments of mechanical piling and burning of fuels would reduce existing and activity fuel load to framework goals. It is expected that there will be some losses (tree damage and/or mortality) from post-treatment piling and burning. Thin barked trees, such as smaller diameter trees and white and red fir, would be most susceptible to damage and/or mortality. Refer to the Fire/fuels report.

Economic Analysis

An economic analysis was done for the areas of commercial harvest using a combination of The Region 5 Transaction Evidence Appraisal System as well as the Quicksilver program. Species compositions were taken from the existing stand condition as reported in FSVeg. The following cost and values were used in the Quicksilver program.

Table 9. Economic Analysis Inputs

Cost or Benefit Name	Type	Year	Quantity	Unit	Value Per Unit
Sawtimber	Benefit	2018	16020	CCF	$ 22.00
Small Tree Removal	Cost	2018	679	Acre	$ 200.00
Tractor Piling	Cost	2018	679	Acre	$ 400.00
Prescribed Burning	Cost	2019	783	Acre	$ 150.00
Hand plant conifers	Cost	2019	75	Acre	$ 200.00
Hand Release	Cost	2023	75	Acre	$ 400.00
PCT	Cost	2025	75	Acre	$ 200.00

The following economic criteria were calculated using the Quicksilver program: Cost Benefit (B/C) Ratio, Net Present Value (NPV) as well as Present Value of Benefits and Present Value (PV) of Costs alone. A discount rate of 4% was used for all costs and benefits.

Table 10. Economic Outputs

Criterion	Value
B/C Ratio	0.49
Net Present Value	-$339,171
PV-Benefits	$325,850
PV-Costs	-$665,021.76

As shown in Table 10, the prescription for the commercial harvest units has negative net present value. This is partially due to relatively low current sawlog values as well as including fuel treatments such as piling and burning. Although the commercial units and project as a whole may have negative net present value, the costs of implementing fuels treatments will still be greatly offset by implementing the silvicultural prescription as a whole. As shown in Table 10, the timber volume removed will produce $325,850.00 to go towards project work.

Strategic Fuel Break Area

Treatments in the fuel break area (a total of approximately 3000 acres) are primarily focused on reducing surface and ladder fuels. It is anticipated that treatments will have the favorable effect of changing areas with a brush dominated understory to being predominately grass and forbs. There will be little effect to stand density and forest health. The effects of these treatments are covered further in the fire and fuels report. There will be a secondary effect of protecting stands from high levels of mortality during wildfire conditions. This is especially true where young plantations are embedded into the fuel break area. Of primary concern in the young plantations is the current high concentration of woody brush. Treatments such as mastication followed up with herbicide will have long term effectiveness in maintaining manageable levels of woody brush that will protect young trees from fire as well as promote growth. As young trees increase in size they will become more resistant to fire by developing thicker bark and increasing crown height. Taller trees with minimal ground and ladder fuels surrounding them may receive some scorching of lower limbs during a prescribed or wildfire yet have enough live canopy to survive.

The proposed action gives the option of initially treating small trees and brush in the fuel breaks with prescribed fire, hand and mechanical methods. The maintenance of the fuel break may be completed using targeted grazing (goats or sheep), prescribed fire, removal by mechanical or hand tools, and herbicide application. Although these different methods can initially provide similar results, the longer term effectiveness and need for continual re-treatment varies. Due to the re-sprouting capability of brush species in the project area, the only maintenance tool that will effectively kill individual shrubs with as little as one treatment is herbicide. This creates the need for numerous re-entries over time with grazing (goats or sheep), prescribed fire, mechanical or hand tools. This can prove impractical due to high costs or limited burn windows (Green, 1977). The use of goats can be problematic for multiple reasons including the need for intensive on-site herding, fencing, and supplying water in remote areas (Green and Newell, 1982). In addition, a major hurdle in using goats for in wildland areas for fuelbreaks is the inability of goat owners to make the operation economically viable.

For the sake of this proposed action it is assumed that it would take repeated treatments by either hand or mechanical means every 3-5 yrs. to keep fuels in a state that would maintain 4 foot flame lengths. Intensive grazing operations would need to be completed as often as twice a year on the same area and then every 1-3 years for the foreseeable future. Prescribed fire would need to be used twice on the same area in a ten year period to achieve desired condition.

Economic Analysis of Fuel Break

A tentative fuel break treatment schedule with associated costs can be found in Appendix B. The assumption is that all available tools will be used to some extent. It is calculated that the cost (present value) to establish and maintain the entire fuel break area is $5,493,261.

Alternative 3-No Herbicide

The No Herbicide alternative will include all the actions/activities in the proposed action except the use of herbicides.

Effects are similar to those described under Alternative 1 with the following exceptions.

Without the use of herbicides, other maintenance tools used to control brush growth would need to occur every 3-5 years to maintain desired condition, thus maintenance costs would increase. The indirect effect of not using herbicide as a maintenance treatment means that brush species will continue to reinvade the fuelbreaks and conversion to the desired conditions is more difficult and more costly with perpetually recurring removal by other means.

In young plantations where there is a large concentration of woody brush, trees would continue to be at higher risk of mortality from wildfire or prescribed fire as brush re-establishes. There would be little to no gain in tree growth as individual shrubs will still be alive and consuming limited resources such as water.

The effects to human health from the use of glyphosate herbicide are documented in appendix A. Although the risk of negative health effects to humans is considered low with the proposed use of glyphosate in the other action alternatives, the elimination of its use would in turn eliminate any potential effect.

Economic Analysis of Fuel Break without Herbicide

Without the use of herbicide, there would be approximately 1,027 acres that would need maintenance through other means. The added estimated cost of using hand and mechanical tools plus additional prescribed burning would be approximately $880,087.

Alternative 4- CA Spotted Owl Interim Recommendations

A full description of this alternative is described in the EA. However the primary difference from the Proposed Action is that approximately 678 acres would be dropped from commercial harvest. This leaves 105 acres that would be commercially harvested using mechanical ground based methods described in the Proposed Action. In addition approximately 240 acres of what was scheduled for commercial harvest in the Proposed Action (outside of strategic fuel break area) will be treated once as strategic fuel break. This 240 acres will not receive fuel break maintenance.

The effects on the 105 acres would be similar to that described for commercial harvest in the proposed action. The effects on the 240 acres of fuel reduction units would be similar to that of the rest of the fuel break area except that these areas have are generally more dense and would see a greater change in the number of trees per acre. In other words there are more areas in the larger fuel break area that have had thinning treatments in the past 20 years and there for have less small trees to remove. There would still overall be little effect on total stand density as measured by basal area and stand density index.

Modeling was performed to simulate the effects in the fuel treatment only units. Post treatment there will be approximately 104 trees per acre and basal area is reduced to 288 sq. ft./ acre. The QMD is increased to 22 inches. Figure 4 shows the diameter distribution post treatment.

Figure 4. Trees per Acre by DBH-1 yr. Post Fuel Treatment Year 2019

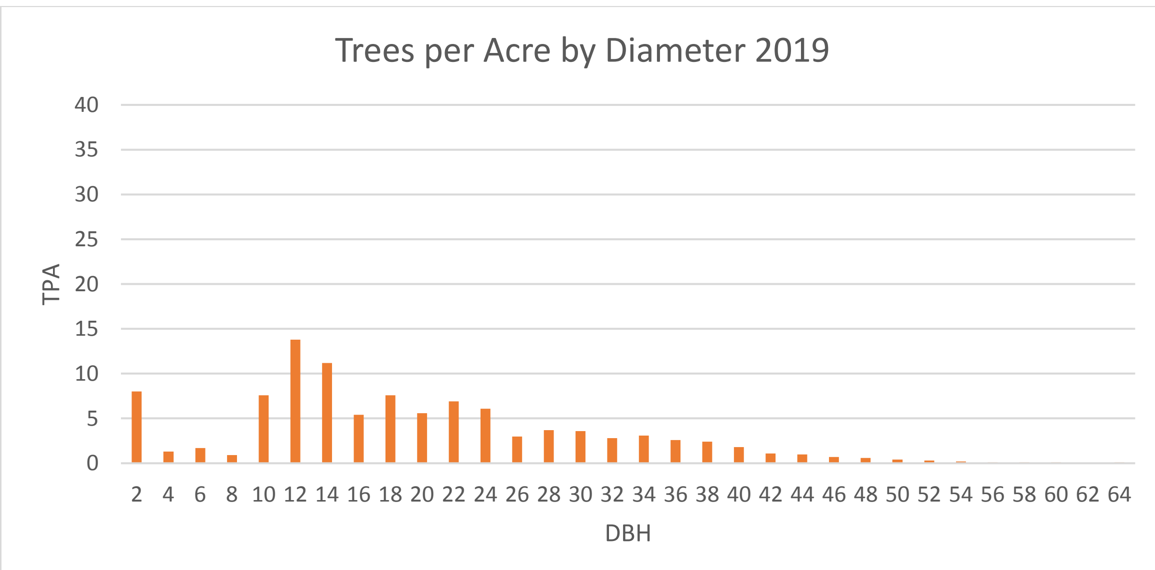


Table 11. SDI by Select Size Classes Post Treatment

Diameter	SDI	% of total
1 - 9.9 in	10	3%
10 - 29.9 in	193	51%
30 - 70.9 in	178	47%
Total	381	100%

As shown in table 16, SDI is reduced to approximately 381 or 66% of maximum.

Table 12. Stand Attributes by Species 2019

Species	TPA	% of total	BA/A	% of total
WF	30	29%	91	32%
IC	46	44%	92	32%
SP	7	7%	46	16%
PP	17	16%	55	19%
BO	4	4%	4	1%
Total	**104**		**288**	

Canopy Cover

Canopy cover is modeled to be approximately 77% post-harvest in the fuel treatment only units.

<u>Discussion of Results from Implementing Fuel Treatment Only Prescription for Alternative 4</u>

The post treatment diameter distribution is shown in figure 4. All of the reduction in trees per acre takes place in the less than 10" DBH size classes.

The prescription as modeled has only slightly reduced stand density. The stand density is not brought below the level stated in the objectives for the project. The percentage of pine in the stands remains unchanged from the existing condition. The total accrued mortality over the 50 year modeling period is 6,729 gross cubic feet per acre. This is approximately 79% of the growth for the same period. This only slightly lower than the no action alternative.

Timber Volume

Using the same volume per acre estimate as the proposed action this alternative would produce 2148 CCF or 1.1 MMBF from the remaining 105 acres of commercial harvest.

Economic Analysis

Using the same input costs as the proposed action, an economic analysis was done for the commercial harvest units along with the fuel treatment only units. As shown in table 13, Alternative 4 has a negative net present value. Because there is less total acres in fuel treatments in commercial and fuel treatment only units the deficit is not as great as sown in the Proposed Action. Again these figures do not include the larger fuel break area which would remain as reported for the Proposed Action. In other words less total acres would be treated, therefor less costs would be incurred.

Table 13. Economic Outputs for Alternative 4

Criterion	Value
B/C Ratio	0.15
Net Present Value	-$255,641.97
PV-Benefits	$43,690.83
PV-Costs	-$299,332.80

Table 14. Comparison of Alternatives

	Current Condition/No Action	Proposed Action (Post Treatment)	Alternative 3-No Herbicide (post treatment)	Alternative 4-IR (post treatment)
Attribute				
TPA	309	60	60	104
BA/Acre	343	210	210	288
SDI	547	265	265	381
% of Pine TPA	23	36	36	23
% of Pine BA	35	45	45	35
50 yr Accurred Mortality (gross CF/Ac)	7122	3217	3217	6729
50 yr Mortality as % of Growth	83	45	45	79
NPV of Strategic Fuel Break Area	0	-$5,493,261	-$6,373,348	-$5,493,261
NPV of Treatments outside Strategic Fuel Break Area (Commmercial Units and IR Fuel Treatments)	0	-$339,171	-$339,171	-$255,642

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Appendix A

Summary of Human Health Risk Assessment

The risk of adverse health effects from the use of any of the pesticides proposed for use on the level and duration of exposure and the inherent toxicity of the pesticide. Possible short-term adverse health effects include nausea, headache, dizziness, eye irritation, and coughing.

A comprehensive analysis of human health risks was conducted to analyze the potential for adverse health effects in workers and members of the public from the proposed use of pesticides. This analysis examines a range of potential exposures to pesticides, from routine operations involving workers, to accidents involving workers and the public. Assumptions regarding rates of use range from average (or typical) rates of use to very high rates of use, representing worst-case scenarios. The project file presents the complete risk assessment. The following summary of pesticide effects is taken from that risk assessment.

This risk assessment examines the potential health effects on all groups of people who might be exposed to any of the pesticides proposed to be used. Those potentially at risk fall into two groups: workers and members of the public. Workers include applicators, supervisors, and other personnel directly involved in the application of herbicides. The public includes other forest workers, forest visitors, and nearby residents who could be exposed through the drift of herbicide spray droplets, through contact with sprayed vegetation, or by eating, or placing in the mouth, food items or other plant materials, such as berries or shoots growing in or near treated areas, by eating game or fish containing herbicide residues, or by drinking water that contains such residues.

The analysis of the potential human health effects of the use of chemical herbicides was accomplished using the methodology generally accepted by the scientific community (National Research Council 1983, United States Environmental Protection Agency 1986). In essence, the risk assessment consists of comparing doses, based on site-specific herbicide use levels, that people might receive from applying the herbicides (worker doses) or from being near an application site (public doses) with the United States Environmental Protection Agency's (U. S. EPA) established Reference Doses (RfD), a level of exposure considered protective of lifetime or chronic exposures. The site-specific risk assessment also examines the potential for these treatments to cause synergistic effects, cumulative effects, and effects on sensitive individuals, including women and children.

Different types of possible effects were considered in the assessment, including acute and chronic systemic effects, cancer and mutations, and reproductive effects. These effects were evaluated using the appropriate animal test data. General systemic effects were evaluated that could range from nausea and headaches at low doses to organ damage, reproductive problems, birth defects, or even mortality at extreme doses. This risk assessment also examined acute toxic effects from accidental exposure scenarios. For each type of dose assumed for workers and the public, a hazard quotient (HQ) was computed by dividing the dose by the RfD. In general, if HQ is less than or equal to 1, the risk of effects is considered negligible. Because HQ values are based on RfDs, which are thresholds for cumulative exposure, they subsume acute exposures. This aspect is discussed below in the evaluations of possible effects.

One of the primary uses of a risk assessment is risk management. Decision makers can use the risk assessment to identify those herbicides, application methods, or exposure rates that pose the greatest risks to workers and the public. Specific mitigation measures can then be employed where the decision maker believes the risks to be unacceptably high. Because the risk assessment is based on a number of assumptions, risk values are not absolute. If assumptions change, the risk values change. However, the relative risk among herbicides or methods would remain valid. Of course, if new toxicity data became available that indicated more adverse response(s) than previous data indicated, the risk assessment would need to be revised.

To facilitate decision making, acceptable risk levels must be established. EPA has established a significant cancer risk level of 1 chance in 1 million; the State of California, through Proposition 65, has established a standard of 1 chance in 1 hundred thousand. The RfD is also an EPA-established measure of acceptable risk for non-carcinogen exposures. This assessment uses the standards of 1 chance in 1 million for cancer risk and the RfD for non-carcinogen exposures.

Alternative 2 and 3

There are no effects from pesticides as this alternative does not propose to use pesticides.

Alternative 1 (Proposed Action), and Alternative 4

<u>Glyphosate</u>

Workers - Given the low hazard quotients for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous. None of the exposure scenarios exceed a level of concern. The simple verbal interpretation of this quantitative characterization of risk is that even under the most conservative set of exposure assumptions, workers would not be exposed to levels of glyphosate that are regarded as unacceptable. Under typical backpack application conditions, levels of exposure will be at least 100 times below the level of concern.

While the accidental exposure scenarios are not the most severe one might imagine, they are representative of reasonable accidental exposures. Given that the highest hazard quotient for any of the accidental exposures is a factor of about 1,000 below the level of concern, more severe and less plausible scenarios would be required to suggest a potential for systemic toxic effects.

Glyphosate and glyphosate formulations are skin and eye irritants. Quantitative risk assessments for irritation are not normally derived, and, for glyphosate specifically, there is no indication that such a derivation is warranted.

General Public – Under normal conditions, members of the general public should not be exposed to substantial levels of glyphosate. The proposed units are near or within parts of the Eldorado National Forest used for dispersed recreation, which might include activities such as hiking, hunting, fishing, woodcutting, berry-picking, or collection of plant materials for basket weaving. The public generally will pass through or near these units while participating in these activities. State Hwy 88 lies within the project area that is planned for herbicide treatment. This a busy highway with recreational traffic as well as individuals traveling between the central valley of CA and South Lake Tahoe as well as Nevada. Individuals may stop at scenic overlooks and turnouts during travel which are adjacent to treatment areas. Signs will be placed at common access points in the project area that will give notice that glyphosate has been applied. This may reduce the chance of individuals unknowingly entering areas where application has occurred.

The two types of exposure scenarios developed for the general public includes acute exposure and longer-term or chronic exposure. All of the acute exposure scenarios are primarily accidental. They assume that an individual is exposed to the compound either during or shortly after its application. Specific scenarios are developed for direct spray, dermal contact with contaminated vegetation, as well as the consumption of contaminated fruit, vegetation, water, and fish. Most of these scenarios should be regarded as extreme, some to the point of limited plausibility. The longer-term or chronic exposure scenarios parallel the acute exposure scenarios for the consumption of contaminated fruit, vegetation, water, and fish but are based on estimated levels of exposure for longer periods after application.

None of the longer-term exposure scenarios approach a level of concern. Although there are several uncertainties in the longer-term exposure assessments for the general public, the upper limits for hazard quotients are sufficiently far below a level of concern that the risk characterization is relatively unambiguous: based on the available information and under the foreseeable conditions of application, there is no route of exposure or scenario suggesting that the general public will be at any substantial risk from longer-term exposure to glyphosate.

For the acute/accidental scenarios, the exposure resulting from the consumption of contaminated vegetation is the scenario with the highest hazard quotient (HQ = 3) at the upper level. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. These upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. The upper range of exposure scenario involves a dose of 5.40 mg/kg bw. While this is an unacceptable level of exposure, it is far below doses that would likely result in overt signs of toxicity, and is over 50 times lower than doses where mild signs of toxicity were apparent (427 mg/kg). Signing and the presence of dye on vegetation would reduce the potential of freshly sprayed material to be consumed.

For the other acute/accidental scenarios, the exposure resulting from the consumption of contaminated water by a child, at the highest application rates, reaches but does not exceed the level of concern (HQ=1). At the exposure level for a child drinking water, as per the discussion in Section 4, no effects would be anticipated for doses up to 20 mg/kg/day. It is important to realize that the exposure scenarios involving contaminated water are arbitrary scenarios: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of glyphosate, all of the hazard quotients would be a factor of 10 less. A further conservative aspect to the water contamination scenario is that it represents standing water, with no dilution or decomposition of the herbicide. This is unlikely in a forested situation where flowing streams are more likely to be contaminated in a spill, rather than a standing pond of water. Nonetheless, this and other acute scenarios help to identify the types of scenarios that are of greatest concern and may warrant the greatest steps to mitigate. For glyphosate, such scenarios involve oral (contaminated water) rather than dermal (spills or accidental spray) exposure. None of the other acute/accidental exposure scenarios approach a level of concern.

Carcinogenicity- Recently, the International Agency for Research on Cancer (IARC) Monograph Working Group determined that glyphosate should be classified as "probably carcinogenic to humans" (Guyton et al 2015). This recent decision was based on a review of existing studies and not on new research. The issue is a particular group of cancers called non-Hodgkin's lymphomas.

In 1991, US EPA concluded that glyphosate should be classified as a Group E (evidence of non-carcinogenicity for humans) based on a lack of convincing carcinogenicity evidence and considering the criteria in EPA Guidelines for classifying a carcinogen.

The USFS human health and ecological risk assessment for glyphosate (USFS 2011), includes a lengthy discussion of the mutagenic and carcinogenic potential of glyphosate including non-Hodgkin's lymphoma (Section 3.1.10). Many of the key references used in Guyton (2015) and another recent, but more in-depth review (Schinasi and Leon, 2014) are discussed in the glyphosate risk assessment. The USFS risk assessment concludes (page 70):

The nature of the available epidemiology data on glyphosate is addressed in the U.S. EPA/OPP (2002) assessment:

This type of epidemiologic evaluation does not establish a definitive link to cancer. Furthermore, this information has limitations because it is based solely on unverified recollection of exposure to glyphosate-based herbicides.

Based on an evaluation of the available animal studies as well as epidemiology studies, U.S. EPA/OPP (2002, p. 60943) classifies the carcinogenic potential of glyphosate as Group E, No Evidence of Carcinogenicity. Given the marginal mutagenic activity of glyphosate (Section 3.1.10.1), the failure of several chronic feeding studies to demonstrate a dose-response relationship for carcinogenicity, and the limitations in the available epidemiology studies on glyphosate, the Group E classification in U.S. EPA/OPP (1993a, 2002) appears to be reasonable.

It has been USFS practice to defer to US EPA unless there is a compelling reason to do otherwise. At this point, there is not yet a compelling reason to adopt the IARC's classification since all the technical details are not yet available from IARC and since US EPA's and our analyses would indicate a different conclusion. As stated, a new risk assessment from US EPA is expected later this year which will undoubtedly consider the IARC's classification. If the US EPA accepts the IARC recommendation, then the USFS would consider an update to the glyphosate RA and for purposes of existing NEPA documents, such a reclassification would be considered ‘new information’.

Borax

Workers - Given the low hazard quotients for accidental exposures, the risk characterization for workers is unambiguous. None of the exposure scenarios exceed a level of concern. Thus, based on the available information and under the foreseeable conditions of application, there is no route of exposure or scenario suggesting that workers will be at any substantial risk from acute exposures to Borax.

Borax can cause eye irritation. Quantitative risk assessments for irritation are not normally derived, However, from a practical perspective eye irritation is likely to be the only overt effect as a consequence of mishandling Borax. This effect can be minimized or avoided by prudent industrial hygiene practices during the handling of the compound. The Sporax label requires eye protection during application.

General Public – For the general public, hazard quotients for consumption of Sporax from a tree stump by a child range from 2 to 16 for ingestion of 50 to 400 mg of Sporax). These estimated levels of exposure are below levels of exposure associated with nonlethal effects such as diarrhea and vomiting by factors of about 4 to 32. Documented lethal doses are in the range 505 mg B/kg/day and 765 mg B/kg/day, factors of about 11 to 135 below the estimated levels of exposure. Thus, while this exposure scenario raises concern in that the RfD could be substantially exceeded in a child directly consuming Sporax from a treated stump, the most likely adverse effects would probably be vomiting and diarrhea.

This scenario most likely would apply to Borax treatments near campgrounds, where children may be present. On the Panther Project the application of Borax would occur to freshly cut stumps during timber sale operations not in proximity of campgrounds. Due to the nature of an active logging operation it is not likely that a child would be in this area of the forest while active logging is taking place.

For consumption of water from a pond contaminated by Borax due to runoff, none of the hazard quotients exceed the level of concern, even for the highest application rate. For this worst-case scenario, the highest hazard quotient for consumption of water contaminated by an accidental spill is 0.7, associated with child consuming water contaminated by the spill of 25 pounds of Sporax into a small pond. Thus, based on this risk assessment, the only exposure scenario that appears to present a significant potential risk is exposure by direct consumption under upper bound conditions. This scenario involving water contamination assumes that a small pond is affected, rather than a creek or river as would be more likely in this forested setting.

Impurities and Metabolites

Virtually no chemical synthesis yields a totally pure product. Technical grade pesticides, as with other technical grade products, contain some impurities. To some extent, concern for impurities in technical grade herbicides is reduced by the fact that existing toxicity studies were conducted using technical grade products. Thus, if toxic impurities are present in a technical grade product, their effects are reflected in the toxicity measurements. An exception to this general rule involves carcinogens, most of which are presumed to pose risks in any concentrations. In the case of the pesticides under consideration, carcinogen impurities are:

- Ethylene oxide potentially in surfactant
- 1,4 dioxane potentially in surfactant

Risk of cancer from exposure to ethylene oxide is considered negligible for occupationally exposed individuals, based on a standard of acceptable risk of 1 in 1 million. Risks from exposure to ethylene oxide are considered acceptable, given the conservative assumptions about exposure. Risks of cancer from the exposure to 1,4-dioxane are considered negligible for occupationally exposed individuals, based on a standard of acceptable risk of 1 in 1 million. Accordingly, risks from 1,4-dioxane exposure are considered acceptable. As with impurities, the potential effects of metabolites is encompassed by the available in vivo toxicity studies, under the assumption that toxicological consequences of metabolism in the species tested would be similar to those of humans. Uncertainties in this assumption are countered by using an uncertainty factor in deriving the RfD and relying upon conservative studies in determining the appropriate RfD.

Other Additives

Surfactants

Nonylphenol Polyethoxylate (NPE-based Surfactants)

Note - The primary active ingredient in many of the non-ionic surfactants used by the Forest Service is a component known as nonylphenol polyethoxylate (NPE). The most common NPE used in surfactants for pesticide is a mixture that has, as a majority, 8-10 ethoxylate groups attached. But it is important to understand that there is a bell-shaped distribution curve around 9 ethoxylate groups (NP9E, shorthand for nonylphenol polyethoxylate with an average of 9 ethoxylate groups. NP9E represents the average surfactant ingredient, even though these surfactants may contain an average of 8 to 10 ethoxylate groups).

Workers - Given the low hazard quotients for accidental exposure, the risk characterization is reasonably unambiguous. None of the accidental exposure scenarios exceed a level of concern. While the accidental exposure scenarios are not the most severe one might imagine (e.g., complete immersion of the worker or contamination of the entire body surface for a prolonged period of time) they are representative of reasonable accidental exposures. While the confidence in this assessment is diminished by the lack of information regarding the dermal absorption kinetics of NP9E in humans, the statistical uncertainties in the estimated dermal absorption rates, both zero-order and first-order, are incorporated into the exposure assessment and risk characterization.

The upper limit of general worker exposure scenarios approach, but don't exceed, a level of concern (HQ = 0.8). The simple verbal interpretation of this quantitative characterization of risk is that under the most conservative set of exposure assumptions, workers should not be exposed to levels of NP9E that are regarded as unacceptable.

NP9E can cause irritation and damage to the skin and eyes. Quantitative risk assessments for irritation are not derived; however, from a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling NP9E. These effects can be minimized or avoided by prudent industrial hygiene practices during handling.

General Public –Although there are several uncertainties in the longer-term exposure assessments for the general public, the upper limits for hazard indices are sufficiently far below a level of concern that the risk characterization is relatively unambiguous: based on the available information and under the foreseeable conditions of application, there is no route of exposure or scenario suggesting that the general public will be at any substantial risk from longer-term exposure to NP9E.

For the acute/accidental scenarios, exposure resulting from the consumption of contaminated water from a spill is of greatest concern. Exposure resulting from the consumption of contaminated vegetation is of somewhat less concern. None of the other acute exposure scenarios represent a risk of effects to the public.

Acute or accidental exposure scenarios involving consumption of contaminated water or consumption of contaminated vegetation represent some risk of effects. None of the other acute exposure scenarios represent a risk of effects to the public from NP9E exposure. At typical rates of application, the drinking of contaminated water after a spill (HQ = 4.6) approaches the level that could present a risk of subclinical effects to the liver and kidney (HQ values between 5 and 10). The upper HQ of 6.9 represents an increasing risk of clinical effects to the kidney, liver, and other organ systems. The exposure scenario for the consumption of contaminated water is an arbitrary scenario: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of NP9E, all of the hazard quotients would be a factor of 10 less. This scenario involving water contamination assumes that a small pond is affected, rather than a creek or river as would be more likely in this forested setting. The contaminated stream scenario presents a more realistic scenario for potential operational contamination of a stream; the HQ values are substantially below one

At high application rates only (HQ = 5.0) the short-term consumption of fruit is at the lower end the level that could present a risk of subclinical effects to the liver and kidney (HQ values between 5 and 10). At the typical rate of application, the HQ is less than one. Signing and the presence of dye on vegetation would reduce the potential of freshly sprayed material to be consumed.

The public exposure scenario involving the consumption of fruit, both short-term (above) and long-term, most closely proxies the use of native material by basketweavers. The highest estimated HQ value for the long-term exposure scenario is 0.08. Plant materials in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable and very unlikely to be selected for basketweaving, medicine or food (Segawa, R., et al, 2001), reducing the likelihood of additive doses.

Methylated Seed Oil and Silicone/Modified Vegetable Oil Blend

These surfactants both have a potential to cause slight skin and eye irritation.

Colorants

- Colorfast® Purple contains a dye, Basic Violet 3 or Gentian Violet, which is considered a potential carcinogen. Based on SERA, 1997b, risk characterization leads to typical cancer risks for workers of 4.7×10^{-7} or 1 in 2.1 million. For the public, the consumption of sprayed berries yielded an estimated single exposure risk of 1 in 37 million to 1 in 294 million. For public exposures, it is expected that the dye would reduce exposures both to itself and to the other chemicals it might be mixed with (herbicide and other adjuvants) as the public would be alerted to the presence of treated vegetation.

- Hi-Light® Blue is considered virtually non-toxic to humans. It is mildly irritating to the skin and eyes.

Synergistic Effects

Synergistic effects (multiplicative) are those effects resulting from exposure to a combination of two or more chemicals that are greater than the sum of the effects of each chemical alone (additive). Based on the limited data available on pesticide combinations involving these herbicides, it is possible, but unlikely, that synergistic effects could occur as a result of exposure to the pesticides proposed for use.

It is not anticipated that synergistic effects would be seen with the herbicides and the adjuvants that might be added to them. Based on a review of several recent studies, there is no demonstrated synergistic relationship between herbicides and surfactants. There is very little information available on the interaction of glyphosate with other compounds. Borax is used as a sole agent for the control of annosum root disease in conifer stands. Thus, it is not expected that application of borax will be combined with other agents. No information has been encountered on the toxicologic interactions of borax with other agents. Based on the very low exposure rates estimated for this project, any synergistic or additive effects are expected to be insignificant.

Sensitive Individuals

The uncertainty factors used in the development of the RfD takes into account much of the variation in human response. The uncertainty factor of 10 for sensitive subgroups is sufficient to ensure that most people will experience no toxic effects. "Sensitive" individuals are those that might respond to a lower dose than average, which includes women and children. The National Academy of Sciences (NAS 1993) found that quantitative differences in toxicity between children and adults are usually less than a factor of approximately 10-fold. An uncertainty factor of 10 may not cover individuals that may be sensitive to pesticides because human susceptibility to toxic substances can vary by two to three orders of magnitude. Factors affecting individual susceptibility include diet, age, heredity, preexisting diseases, and life style. Individual susceptibility to the pesticides proposed in this project cannot be specifically predicted. Unusually sensitive individuals may experience effects even when the HQ is equal or less than 1.

No reports were encountered in the glyphosate literature leading to the identification of sensitive subgroups. There is no indication that glyphosate causes sensitization or allergic responses, which does not eliminate the possibility that some individuals might be sensitive to glyphosate as well as many other chemicals. The primary targets for boron toxicity are the developing fetus and the testes. Thus, exposure of pregnant women to borate compounds places the developing fetus at risk. Since the oral (chronic) RfD for boron and borates is based on the effects in the developing fetus, risk to this subgroup is assessed throughout the SERA risk assessment. Regarding other sensitive subgroups, males with underlying testicular dysfunction could be at increased risk for boron-induced testicular toxicity; however, no data are available to quantify this risk.

Cumulative Effects

The proposed use of herbicides could result in cumulative doses of herbicides to workers or the general public. Where individuals could be exposed by more than one route, the risk of such cases can be quantitatively characterized by adding the hazard quotients for each exposure scenario. For example, using glyphosate as an example, the typical levels of exposure for a woman being directly sprayed on the lower legs, staying in contact with contaminated vegetation, eating contaminated fruit, and consuming contaminated fish leads to a combined hazard quotient of 0.32. Similarly, for all of the chronic glyphosate exposure scenarios, the addition of all possible pathways lead to hazard quotients that are substantially less than one. Similar scenarios can be developed with the other herbicides. This risk assessment specifically considers the effect of repeated exposure in that the chronic RfD is used as an index of acceptable exposure. Consequently, using the typical rates of application, repeated exposure to levels below the toxic threshold should not be associated with cumulative toxic effects.

Since these herbicides persist in the environment for a relatively short time (generally less than 1 year), do not bio-accumulate, and are rapidly eliminated from the body, additive doses from re-treatments in subsequent years are not anticipated. According to recent work completed by the California Department of Pesticide Regulation, some plant material contained glyphosate residues for up to 66 weeks after treatment; however, these levels were less than 1 part per million (Segawa et al. 2001). Since repeat treatments in this project are at one or more years into the future, it is likely that any residue from an application would be substantially degraded between applications. It is possible that residues from the initial herbicide application could still be detectable during subsequent re-treatments, but these plants would represent a low risk to humans as they would show obvious signs of herbicide effects as so would be undesirable for collection.

Cumulative effects can also be caused by different chemicals having a common metabolite or a common toxic action. Neither glyphosate or borax has been demonstrated to share a common metabolite with other pesticides.

References

Contained in Full Project Risk Assessment (Project Record)

Appendix B

Tentative Fuel Break Treatment Schedule for Proposed Action and Alternative 4

Treatment	Cal Year	Acres Treated	Cost/Acre
Hand Treatment Thin Pile	2018	300	$500.00
Hand Treatment Thin Pile	2019	300	$500.00
Hand Treatment Thin Pile	2020	300	$500.00
Hand Treatment Thin Pile	2022	300	$500.00
Hand Treatment Thin Pile	2023	300	$500.00
Hand Treatment Thin Pile	2026	300	$500.00
Hand Treatment Thin Pile	2027	300	$500.00
Herbicide	2021	200	$300.00
Herbicide	2022	200	$300.00
Herbicide	2023	200	$300.00
Herbicide	2024	200	$300.00
Herbicide	2025	200	$300.00
Herbicide	2026	200	$300.00
Herbicide	2027	200	$300.00
Mastication	2018	700	$600.00
Mastication	2019	700	$600.00
Mastication	2020	700	$600.00
Mastication	2022	700	$600.00
Mastication	2023	700	$600.00
Mastication	2026	700	$600.00
Mastication	2027	700	$600.00
Goats	2019	200	$100.00
Goats	2021	200	$100.00
Goats	2023	200	$100.00
Goats	2025	200	$100.00
Goats	2027	200	$100.00
Prescribed burning	2019	1000	$150.00
Prescribed burning	2020	1000	$150.00
Prescribed burning	2021	1000	$150.00
Prescribed burning	2025	1000	$150.00
Prescribed burning	2026	1000	$150.00